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The Arkansas Catalyst

January 2014

University Awards SEC-Supported Faculty Travel Grants

Wen Zhang grows algae in flasks in her lab in the College of Engineering. Using an SEC Visiting Faculty Travel Grant, Zhang will meet with researchers at the University of Florida this spring.

For the second consecutive year, the University of Arkansas has awarded four $2,500 travel grants to faculty who plan to conduct research at other institutions in the Southeastern Conference.

The SEC Visiting Faculty Travel Grant Program is intended to enhance faculty collaboration that stimulates scholarly initiatives amongthe conference's 14 member universities. It gives faculty from one SEC university the opportunity to travel to another SEC campus to exchange ideas, develop grant proposals, and conduct research.

A maximum of four travel grants — funded by the SECU academic initiative — are available to each university for visiting faculty to use during an appropriate period, such as a sabbatical leave, the summer or a designated university break. The visiting faculty member may consult with faculty and/or students, offer lectures or symposia, or engage in whatever activities are productive for the visitor and host campus.

All areas of research and scholarly activity were eligible for support. The U of A faculty selected for travel grants are: Thad Scott, crop, soil and environmental science; Shannon Servoss, chemical engineering; Jennifer Veilleux, psychology; Wen Zhang, civil engineering.

Scott, an assistant professor of environmental water science, will visit the laboratory of Alan Wilson in the School of Fisheries at Auburn University. Scott and Wilson share a converging interest in harmful algal blooms and their effect on water quality. According to Scott, the

project would benefit the U of A because it will allow him to learn the techniques necessary to quantify algal toxins in freshwater environments.

Servoss, who holds the Ralph E. Martin Professorship in Chemical Engineering, will visit Melissa Moss at the University of South Carolina. Moss, a renowned Alzheimer's disease researcher, is an associate professor in the department of chemical engineering and undergraduate director for biomedical engineering at the University of South Carolina. Research in Servoss' lab at the U of A intersects with Moss' in the area of Alzheimer's disease therapeutics.

Veilleux, an assistant professor of psychological science, will visit the the Personality and Emotion Laboratory at the University of Missouri at Columbia, where she will learn how to set up and run data collection using ambulatory assessment. Trull, curator's professor of psychological sciences and Byler Distinguished Professor, is an expert on use of ambulatory assessment techniques in clinical psychology.

Zhang, an assistant professor of civil engineering, will visit the lab of Eric McLamore at the University of Florida. McLamore's research group focuses on development and application of sensor/biosensor technology for solving hypothesis-driven research questions in the life sciences. It builds optical and electrochemical tools from the nanometer to the millimeter spatial scale, often incorporating biological molecules as an active element.

Each of these projects has the potential to become a fully supported research collaboration. The SEC Visiting Faculty Travel Grant is one of several programs of the SECU academic initiative. SECU, headquartered in Birmingham, Ala., sponsors, supports and promotes collaborative higher education programs and activities involving administrators, faculty and students at its member universities.

U of A, NanoMech Install R&D 100 Award

Ajay Malshe

NanoMech, a company affiliated with the University of Arkansas, installed its prestigious "Oscar of Innovation" award at the university on Dec. 19.

The R&D 100 plaque, which signifies NanoMech's inclusion in R&D Magazine's 2013 list of the year's top technological innovations, will be permanently displayed in the University of Arkansas' Institute for Nanoscience and Engineering.

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IN OTHER NEWS

"This research was nurtured on the University of Arkansas campus and helped through the commercialization process at the Arkansas Research and Technology Park," Chancellor G. David Gearhart told he crowd at the event. "New ventures based on university research serve as a key way to keep highly-skilled science, engineering and business graduates right here in Arkansas. "

The magazine based its R&D 100 award on Tufftek, which greatly decreases wear, reduces heat resistance and improves precision for cutting tools. The technology behind Tufftek was invented and patented at the University of Arkansas and licensed to NanoMech for its commercialization and continued development.

Ajay Malshe, a Distinguished Professor of mechanical engineering, founded NanoMech in 2002.

"NanoMech could not have received this prestigious award without the interdisciplinary, out-of-the-box thinking and tireless work of our world-class team of scientists, including Dr. Wenping Jiang, vice president of manufacturing," Malshe said.

"I would also like to thank the teams at the Institute for Nanoscience and Engineering at the University of Arkansas, the National Science Foundation and the Environmental Protection Agency for their contributions over the years."

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Biologist Performs DNA Analysis of Ancient Plant

Andrew J. Alverson

A new study has uncovered an unprecedented example of horizontal gene transfer — the acquisition of foreign DNA from different, unrelated species — in a South Pacific shrub that is considered to be the sole survivor of one of the two oldest lineages of flowering plants.

The research also shows, for the first time, that an organelle genome has captured an entire foreign genome, in this case, at least four of them. It is also the first

Women's Strategies for Global and Social Mobility in Tanzanian Beauty Pageants

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GRANT AWARD WINNERS

The following is a sampling of grants awarded to faculty in December, with the principal investigator, the award amount and the sponsor.

• Brent Williams, $5,080,774, Arkansas Department of Education

• James L. Gattis, $90,341, Texas A&M University System

description of a land plant acquiring genes from green algae.

A full description of the study of Amborella trichopoda was published in the Dec. 20 issue of the journal *Science*. Andrew J. Alverson, an assistant professor of biological sciences in the J. William Fulbright College of Arts and Sciences, has been working on this project since his arrival at the University of Arkansas in 2012. Scientists at Indiana University led the study.

Alverson performed the computational analyses that identified the many donors of this foreign DNA, which includes entire mitochondrial genomes from three green algae and one moss. Alverson and his colleagues found that the plant's mitochondrial genome is enormous, consisting of nearly 4 million nucleotides, which is about 240 times larger than a human mitochondrial genome.

"The Amborella mitochondrial genome is huge, and most of its DNA is foreign, acquired from the mitochondrial genomes of other plant species," Alverson said. "We've never seen horizontal gene transfer at this scale. It's not acquiring genes or bits of genes in a piecemeal way. It's been swallowing up whole genomes. One of our main tasks was to determine the ancestry of its several hundred 'extra' genes."

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Bone Shows Early Evolution of Human Hand

J. Michael Plavcan

A recently discovered bone from the hand of an East African hominim provides the earliest record of a structural feature related to tool use. At 1.42 million years old, the bone is evidence of the evolution of a distinctive feature of modern hands more than half a million years earlier than previously known.

J. Michael Plavcan, a professor of anthropology in the J. William Fulbright College of Arts and Sciences, was part of the research team that analyzed the bone.

"Modern human hands are specialized to hold tools, but hand bones are difficult to find, and we haven't known when modern human hands developed," Plavcan said. "With this discovery, we have the earliest evidence of the structural changes of the hand that are associated with tool use."

In an article published in the *Proceedings of the National Academy of Science*, the researchers wrote that the newly discovered bone "suggests that an increased reliance on manipulatory behaviors indicated by the archeological record early in the Pleistocene selected for the modern human hand early in the evolution of the genus Homo."

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CONTACT US

Vice Provost for Research and Economic Development
205 Administration Building
1 University of Arkansas
Fayetteville, AR 72701
479-575-2470
Website: vpred.uark.edu

email us

University of Arkansas Arkansas Newswire

University of Arkansas, NanoMech Install Prestigious R&D 100 Award

Technology company was founded by U of A professor in 2002

Thursday, December 19, 2013

FAYETTEVILLE, Ark. –NanoMech, a company affiliated with the University of Arkansas, installed its prestigious "Oscar of Innovation" award at the university on Thursday.

Jim Phillips, CEO of NanoMech (from left), Ajay Malshe, NanoMech founder and Distinguished Professor of mechanical engineering at the University of Arkansas, and Chancellor G. David Gearhart unveil the company's R&D 100 award. Photo by Russell Cothren, University of Arkansas

The R&D 100 plaque, which signifies NanoMech's inclusion in *R&D Magazine*'s 2013 list of the year's top technological innovations, will be permanently displayed in the University of Arkansas' Institute for Nanoscience and Engineering.

"This research was nurtured on the University of Arkansas campus and helped through the commercialization process at the Arkansas Research and Technology Park," Chancellor G. David Gearhart told he crowd at the event. "New ventures based on university research serve as a key way to keep highly-skilled science, engineering and business graduates right here in Arkansas. "

The magazine based its R&D 100 award on Tufftek, which greatly decreases wear, reduces heat resistance and improves precision for cutting tools. The technology behind Tufftek was invented and patented at the University of Arkansas and licensed to NanoMech for its commercialization and continued development.

NanoMech is the only Arkansas company on the 2013 R&D 100. The firm maintains offices at its manufacturing plant and laboratories in Springdale, Ark., and at the

Arkansas Research and Technology Park, which is managed by the University of Arkansas Technology Development Foundation.

Jim Phillips, NanoMech's chief executive officer, emphasized the company's research partnership with the University of Arkansas.

"We maintain an outstanding relationship with the University of Arkansas in technology transfer and commercialization," Phillips said. "The vast majority of our engineers and scientists are University of Arkansas graduates and have trained on the analytical equipment.

"The Institute of Nanoscience and Engineering is a major regional asset to NanoMech as we utilize the vast array of scientific apparatuses and electron microscopes to help advance our technology and industry breakthrough products that increase America's global manufacturing competitiveness," he said.

Phillips added that of NanoMech's 35 employees, 80 percent graduated from the U of A. The company is planning to expand by 10 employees in the near future, he said.

Ajay Malshe, a Distinguished Professor of mechanical engineering at the University of Arkansas, founded NanoMech in 2002.

"NanoMech could not have received this prestigious award without the interdisciplinary, out-of-the-box thinking and tireless work of our world-class team of scientists, including Dr. Wenping Jiang, vice president of manufacturing," Malshe said. "I would also like to thank the teams at the Institute for Nanoscience and Engineering at the University of Arkansas, the National Science Foundation and the Environmental Protection Agency for their contributions over the years."

In 2005, the University of Arkansas licensed technology and patents to NanoMech so the company could commercially develop its products.

"NanoMech presented a check for $375,000 in royalty payments to the university at the dedication of this very building two years ago," Gearhart said. "NanoMech has gone on to pay the U of A nearly $200,000 in royalty payments since then."

NanoMech's breakthroughs in nano-materials and manufacturing include the first cubic boron nitride coating for machine tools and advanced nano-engineered lubricants. As an internationally competitive nanomaterials science and manufacturing company, NanoMech's products have applications in machining and manufacturing, lubrication and energy, sustainable protective coatings for textiles and other consumer products, strategic military applications and biomedical implant functional coatings.

In developing TuffTek and other advanced technologies, NanoMech uses the institute's scanning electron microscope for surface morphology, cross-sectional analysis and elemental analysis. It uses the institute's transmission electron microscope for grain/crystal size analysis and elemental analysis. The institute's X-ray diffraction allows the firm to determine crystal structures/orientation and for estimating crystalline.

Malshe, the company's chief technology officer, is the Twenty-First Century Professor of Materials, Manufacturing and Integrated Systems in the university's College of Engineering.

The R&D Top 100 list was established in 1963 and over the past 51 years has recognized such revolutionary products as the flashcube (1965), the automated teller machine (1973), the halogen lamp (1974), the fax machine (1975), the liquid crystal display (1980), the Kodak Photo CD (1991) and HDTV (1998).

Contacts:

Ajay Malshe, Distinguish Professor, mechanical engineering
College of Engineering
479-575-6561, apm2@uark.edu (mailto:apm2@uark.edu)

Jim Phillips, CEO
NanoMech
479-695-8100, jim.phillips@nanomech.com (mailto:jim.phillips@nanomech.com)

Chris Branam, research communications writer/editor
University Relations
479-575-4737, cwbranam@uark.edu (mailto:cwbranam@uark.edu)

University of Arkansas Arkansas Newswire

Scientists Reveal Driving Force Behind Mitochondrial 'Sex' in Ancient Flowering Plant

Computational analysis of plant DNA featured in Science

Thursday, December 19, 2013

FAYETTEVILLE, Ark. – A new study has uncovered an unprecedented example of horizontal gene transfer — the acquisition of foreign DNA from different, unrelated species — in a South Pacific shrub that is considered to be the sole survivor of one of the two oldest lineages of flowering plants.

Andrew J. Alverson, Amborella in fruit

The research also shows, for the first time, that an organelle genome has captured an entire foreign genome, in this case, at least four of them. It is also the first description of a land plant acquiring genes from green algae.

A full description of the study of *Amborella trichopoda* will be published in the Dec. 20 issue of the journal *Science*, in an article (http://www.sciencemag.org/content/342/6165/1468.full?sid=3e34e165-2a63-45b3-a53d-eeaebf89f6e5) titled, “Horizontal Gene Transfer of Entire Genomes via Mitochondrial Fusion in the Angiosperm Amborella.”

Andrew J. Alverson, an assistant professor of biological sciences in the J. William Fulbright College of Arts and Sciences, has been working on this project since his arrival at the University of Arkansas in 2012. The study, led by scientists at Indiana University, also included researchers from the U.S. Department of Energy, Pennsylvania State University and the Institute of Research for Development in New Caledonia, an archipelago located 750 miles east of Australia where *Amborella* is endemic.

Alverson performed the computational analyses that identified the many donors of this foreign DNA, which includes entire mitochondrial genomes from three green algae and one moss. *Amborella* is the “last man standing” in one of the two oldest flowering plant

lineages. The other lineage comprises the remaining 300,000 species of flowering plants.

Alverson and his colleagues found that the plant's mitochondrial genome is enormous, consisting of nearly 4 million nucleotides, which is about 240 times larger than a human mitochondrial genome.

"The *Amborella* mitochondrial genome is huge, and most of its DNA is foreign, acquired from the mitochondrial genomes of other plant species," Alverson said. "We've never seen horizontal gene transfer at this scale. It's not acquiring genes or bits of genes in a piecemeal way. It's been swallowing up whole genomes. One of our main tasks was to determine the ancestry of its several hundred 'extra' genes."

The plant's mitochondrial genome is unusual for at least three reasons, Alverson said.

"Ecologically, it has greater exposure to the foreign mitochondria of epiphytes and parasites than most plants," he said. "Developmentally, *Amborella* has a greater chance of incorporating this DNA in a new germline due to the plant's propensity to respond to wounding by forming new germlines (meristems) and branches (called suckers). Molecularly, there is a greater chance of keeping this DNA due to its exceptionally low rate of DNA loss.

"One of the really interesting things about *Amborella* is that although it is loaded with all of this extra DNA, most of it is junk," Alverson said. "The genes are degenerated and nonfunctional. *Amborella* is a hoarder. Its genome is a museum of dead DNA."

Scientists are interested in the mechanisms behind horizontal gene transfer as an evolutionary force, and in this case, the role that mitochondrial fusion — the merger of two mitochondria within a cell — plays in horizontal gene transfer between mitochondrial genomes, Alverson said. Mitochondria are structures within certain cells that convert chemical energy from food into a form that cells can use.

The research group determined that the large amount of "junk DNA" in *Amborella* provides evidence that mitochondrial fusion in plants is incompatible with the way mitochondrial fusion occurs in animals or fungi, Alverson said.

Indeed, Jeff Palmer, Distinguished Professor of biology at Indiana University, a lead researcher in the study, said this incompatibility "provides the major barrier to unconstrained mitochondrial 'sex' across the evolutionary tree of life." Palmer was Alverson's postdoctoral adviser at Indiana.

"The *Amborella* mitochondrial genome is like the old lady in the song who swallows a fly, and then a spider, a bird, a cat, etc., all the way to a horse, at which point, finally, 'she's dead of course,'" Palmer said. "Likewise, the *Amborella* genome has swallowed whole

mitochondrial genomes, of varying sizes, from a broad range of land plants and green algae. But instead of bursting from all this extra, mostly useless DNA, or purging the DNA, it's held on to it for tens of millions of years. So you can think of this genome as a constipated glutton, that is, a glutton that has swallowed whole genomes from other plants and algae and also retained them in remarkably intact form for eons."

Contacts:

Andrew J. Alverson, asssistant professor, biological sciences
J. William Fulbright College of Arts and Sciences
479-575-7975, aja@uark.edu (mailto:aja@uark.edu)

Chris Branam, research communications writer/editor
University Relations
479-575-4737, cwbranam@uark.edu (mailto:cwbranam@uark.edu)

University of Arkansas Arkansas Newswire

Newly Discovered Bone Shows Early Evolution of Human Hand

Finding shows earliest hand structure for tool use

Tuesday, December 17, 2013

FAYETTEVILLE, Ark. – A recently discovered bone from the hand of an East African hominim provides the earliest record of a structural feature related to tool use. At 1.42 million years old, the bone is evidence of the evolution of a distinctive feature of modern hands more than half a million years earlier than previously known.

Comparisons of third metacarpals with the recently discovered bone from Kenya on the right. Copyright Carol V. Ward.

"Modern human hands are specialized to hold tools, but hand bones are difficult to find, and we haven't known when modern human hands developed," said J. Michael Plavcan, professor of anthropology at the University of Arkansas. "With this discovery, we have the earliest evidence of the structural changes of the hand that are associated with tool use."

The bone was discovered by Fredrick Kyalo Manthi of the National Museums of Kenya at the Kaitio site in Kenya, and it was analyzed by a team including Plavcan, Carol Ward of the University of Missouri, Matthew Tocheri of the Smithsonian Institution and Francis Brown of University of Utah.

When the team examined the third metacarpal bone, they found that it displayed a styloid process, a curved projection at the end of the bone. The styloid process is important to a hand that uses tools with both dexterity and precision. The styloid process locks in place with the other wrist bones and assists in resisting the forces that result from holding tools and applying pressure.

Stone tools date back at least 2.58 million years, yet until this discovery, the earliest

evidence of structural characteristics related to tool use dated back just 800,000 years.

In an article published in the Proceedings of the National Academy of Science, the researchers wrote that the newly discovered bone "suggests that an increased reliance on manipulatory behaviors indicated by the archeological record early in the Pleistocene selected for the modern human hand early in the evolution of the genus *Homo*."

"There's still a huge gap in our understanding of the evolution of the hand," Plavcan said. "We need to find even earlier bones to determine just when structural features of the hand appeared."

The 1.42 million-year-old metacarpal was discovered at the Kaitio site in Kenya. Copyright Carol V. Ward.

Plavcan is professor of anthropology in the J. William Fulbright College of Arts and Sciences at the University of Arkansas. He is a principal member of the West Turkana Paleontology Project, working with Manthi, the project leader, and Ward. Plavcan's fieldwork is centered on Kanapoi, the type site of *Australopithecus anamensis*. The project draws on the expertise of an international team of researchers to understand the fauna and environment of the Kanapoi site, which is crucial to understanding the origins of the australopithecines and, ultimately, humans. Plavcan's research has been funded by the National Science Foundation, the Wenner-Gren Foundation, the Leakey Foundation, the National Institute for Dental Research, Sigma Xi and several university grants.

Contacts:

J. Michael Plavcan, professor, anthropology
J. William Fulbright College of Arts and Sciences
479-575-2546, mplavcan@uark.edu (mailto:mplavcan@uark.edu)

Barbara Jaquish, science and research communications officer
University Relations
479-575-2683, jaquish@uark.edu (mailto:jaquish@uark.edu)